The Aspen simulations used were able to thermally rate all of the heat exchangers, but provided little to no help in designing them. To help design heat exchangers for our applications to withstand our operating temperatures and to meet our mechanical and thermal criteria we looked to TEMA – Tubular Exchanger Manufacturers Associations –for further information.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Utility | Typical TEMA type heat exchanger | Description of TEMA type heat exchanger | Removable tube bundle | Tubes can be cleaned internally by rodding | Non-hazardous liquids and gases below 40 barg (~580 psig) | | Non-hazardous liquids and gases above 40 barg (~580 psig) | Hazardous liquids and gases | No gaskets in contact with process side | Ability to resist thermal shock |
| Below 190°C | Above 190°C |
| Majority of Heat Exchangers | AEW  BEW | Externally sealed Floating tube sheet | Yes | Yes | Yes | No | No | No | No | No |
| Heat Exchanger Involving Cobalt Catalyst | AEL  BEM | Fixed tube sheet | No | Yes | Yes1 | Yes1 | Yes | Yes | Yes2 | No |
| \*Note: !. Expansion bellows may be required 2. Shell side only | | | | | | | | | | |

For all but one of the heat exchangers will there not be any hazardous liquids or gases. As a result, these heat exchanges follow a certain type of arrangement. According to TEMA, these externally sealed floating tube sheet heat exchanges follow one of two arrangements – these being an AEW or BEW arrangement. For the one heat exchanger that involves a hazardous liquid – containing our cobalt catalyst – the more basic heat exchanger that TEMA offers capable of containing hazardous liquids was chosen. This fixed tube sheet heat exchanger comes in one of two arrangements – either an AEL or BEM design. From these three-letter coding system a picture can be built up of the final shell and tube assembly, consisting of a front-end stationary head, a shell type, and a rear-end head. For most of our heat exchangers, their design will look one of two ways:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Three-Letter Coding System | Front End Stationary Head Type | Shell Types | Rear End Head Types |
| Majority of Heat Exchangers | AEW |  |  |  |
| BEW |  |  |  |
| Heat Exchanger Containing Cobalt Catalyst | AEL |  |  |  |
| BEM |  |  |  |